N92-14504

RESEARCH SUMMARY

A. Title: Measurement of the Solar UV Flux in the Stratosphere

B. Principal Investigator: James E. Mentall
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C. Abstract:

Measurements of the direct solar flux from balloons at an altitude of 40 km are used to determine the effective cross sections of the Schumann-Runge bands. Transmission in these bands, which lie between 180 and 200 nm, allows the Sun's radiation in this region of the spectrum to penetrate into the lower mesosphere. Measurements by a high resolution scanning spectrometer (0.02 nm) is used to measure the transmission in the Schumann-Runge bands. Since ozone also absorbs in this wavelength region, a low resolution scanning spectrometer (0.25 nm) measures the transmission between 220 and 260 nm allowing the column ozone to be determined. Absorption due to Ozone can then be calculated and the data corrected for this effect.

D. Summary of Progress and Results:

After several falures of the solar pointing system, a successfull flight has been obtained. Data from this flight is being analyzed.

Biennial Research Summary

A. Title: Stratospheric Fourier Spectroscopy

B. Principal Investigator: Geoffrey C. Toon
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C. Abstract of Research Objectives:

To measure high resolution infrared solar absorption spectra from ground-based, airborne and balloon-borne platforms using the JPL MkIV interferometer. These spectra will then be analyzed in order to determine the abundances of 20-30 different atmospheric gases, many of which play a central role in determining the global distribution of ozone. These spectra will be measured in a variety of latitudes and seasons in order to test photochemical models of the atmospheric composition under a range of different conditions.

D. Summary of Progress and Results during 1988 and 1989:

The main activity during the first part of 1988 was the analysis of some 1000 spectra recorded from the DC-8 aircraft during the AAOE campaign of 1987. This work confirmed our findings of the NOZE I campaign of 1986: the interior of the vortex is depleted in NO2, HNO3 and HCl; large quantities of ClNO3 reside at the vortex edge; and descent occurs within the vortex, as implied by the depleted abundances of tropospheric source gases such as N2O, CH4, CFC-12, together with enhanced abundances of HF.

During the second half of 1988 preparation were made for the 1989 AASE campaign. This included installation of the MkIV interferometer back onto the NASA DC-8 aircraft at the NASA Ames facility followed by three test flights. To perform rapid analysis of the our spectra in the field a new computer system was purchased and processing and analysis software was developed on this system.

During the first six weeks of 1989 the MkIV interferometer team were in Stavanger, Norway, participating in the AASE campaign. Over the course of more than a dozen DC-8 flights, more than 2000 spectra (4 Gbytes of data) were recorded. We were able to coarsely analyze the spectra for O3, NO, NO2, HNO3, HCl, ClNO3 and H2O within 24 hours of each DC-8 flight, allowing these results to be factored into the planning of subsequent flights. The results themselves show an unexpected similarity to those obtained over Antarctica, with the exception that the abundances of HNO3 and H2O were much larger in the North, a consequence of the warmer temperatures.

Since the AASE campaign, our main thrust has been in the preparation for the Fall 89 balloon flight from Fort Sumner, New Mexico. Although this will its first balloon flight, it must not be forgotten that the MkIV interferometer was originally designed to fly on balloons and that limb sounding from a platform at 40km altitude is undoubtedly the optimum geometry for investigating the composition of the stratosphere. We therefore anticipate some exciting results from this flight.

E. Journal Publications in 1988 & 1989

G.C.Toon, C.B.Farmer, P.W.Schaper, J.-F.Blavier and L.L.Lowes "Ground-based infrared measurements of tropospheric source gases over Antarctica during the 1986 Austral Spring", JGR (in press)

G.C.Toon, C.B.Farmer, L.L.Lowes, P.W.Schaper, J.-F.Blavier and R.H.Norton, "Infrared Aircraft measurements of stratospheric composition over Antarctica during September 1987" JGR (in press)

G.C.Toon and C.B.Farmer, "Detection of HOCl in the Antarctic Stratosphere", accepted by GRL

S.Kinne, O.B.Toon, G.C.Toon, C.B.Farmer, E.V.Browell and M.P.McCormick, "Measurements of size and composition of particles in polar stratospheric clouds from solar absorption spectra", JGR (in press)

J.J.Margitan, G.A.Brothers, E.V.Browell, D.Cariolle, M.T.Coffey, J.C.Farmen, C.B.Farmer, G.L.Gregory, J.W.Harder, D.J.Hoffman, W.Hypes, S.Ismail, R.O.Jakoubek, W.Komhyr, S.Kooi, A.J.Krueger, J.C.Larsen, W.Mankin, M.P.McCormick, G.H.Mount, M.H.Proffitt, A.R.Ravishankara, A.L.Schmeltekopf, W.L.Starr, G.C.Toon, A.Torres, A.F.Tuck, A.Wahner, I.Watterson, "Intercomparison of ozone measurements over Antarctica", JGR (in press)

A. Title of Research Task: Balloon Microwave Limb Sounder (BMLS) stratospheric measurements.

B. Investigators: R.A. Stachnik and J.W. Waters
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C. Abstract of Research Objectives: The objective of this program is measure abundance and variability of stratospheric trace constituents which influence stratospheric ozone using balloon-borne millimeter and sub-millimeter wave spectrometers. The present instrumentation simultaneously measures O_3 and ClO, a key indicator of Cl-catalyzed O_3 destruction. A second instrument, now being built, will have a capability to simultaneously measure ClO, O_3, HCl, HO_2, HNO_3, and N_2O. This program also provides a background for development of satellite instrumentation which can yield measurements on a global scale. Technology developed by this program has been used in the Microwave Limb Sounder (MLS) instrument on Upper Atmosphere Research Satellite (UARS) and will be essential to the development of the proposed MLS instrument on the Earth Observing System (EOS) platform.

D. Summary of Progress and Results:

1. The BMLS instrument was successfully flown from the National Scientific Balloon Facility (NSBF) site at Ft. Sumner NM. in September 1988 and from the Palestine, TX site in May 1989. The latter flight was the first balloon-based measurement using the UARS MLS development filter bank spectrometers and provided measurements of both O_3 and ClO with approximately 15 minutes time resolution through a sunset transition. Representative raw spectral data from this flight for ClO is shown in Figure 1. Figure 2 shows retrieved ClO mixing ratio profiles from *single* limb scans. The BMLS instrument currently has spectral

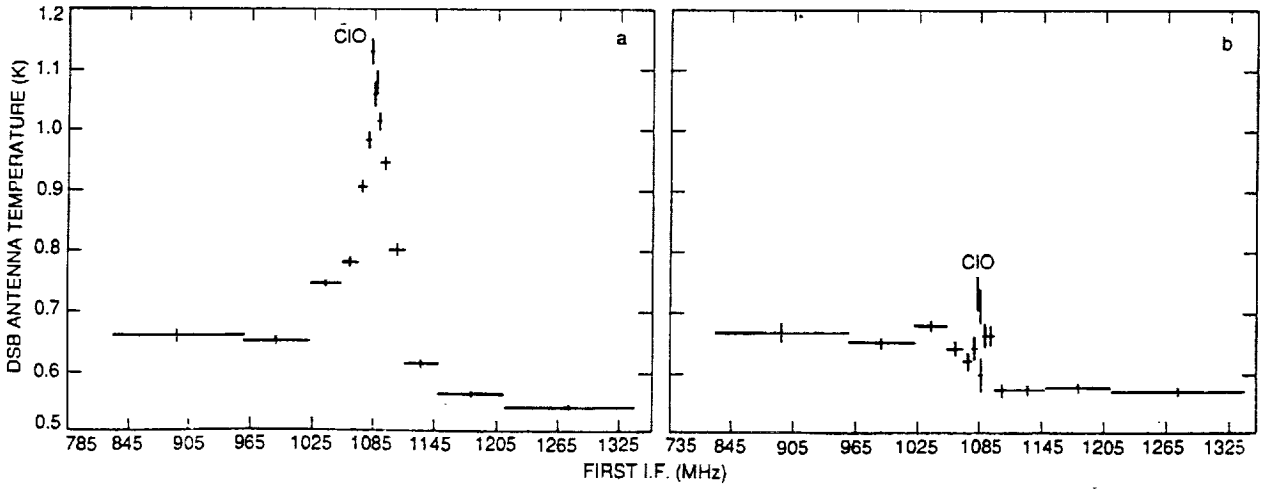

Figure 1: (a) Daytime ClO emission spectrum from 33-34 km tangent height. (b) Night ClO emission from 33-34 km. Integration time of each spectrum $\sim$ 300 seconds.

coverage and resolution identical to that of the 205 GHz subsystem of the UARS MLS instrument. Publications of these results are in preparation.

2. Ground-based microwave measurements of stratospheric O_3 were made at the Jet Propulsion Laboratory Table Mountain Observatory in February-March 1989 . These results were compared with simultaneous measurements by the JPL Table Mountain LIDAR and found to agree to within 5%.

3. A submillimeter wave radiometer is being built to provide simultaneous measurement of ClO, O_3, HCl, HO_2, HNO_3, and N_2O and will be capable of balloon-borne or aircraft operation. The first balloon flight of this instrument is planned for September 1990.

4. A joint balloon flight of the BMLS instrument, the far infrared spectrometer of the Smithsonian Astrophysical Observatory, and the JPL far infrared limb observer is planned for September 1989 from Ft. Sumner NM. A goal of this effort is to determine the stratospheric abundance of chlorine as ClO, HCl and HOCl.

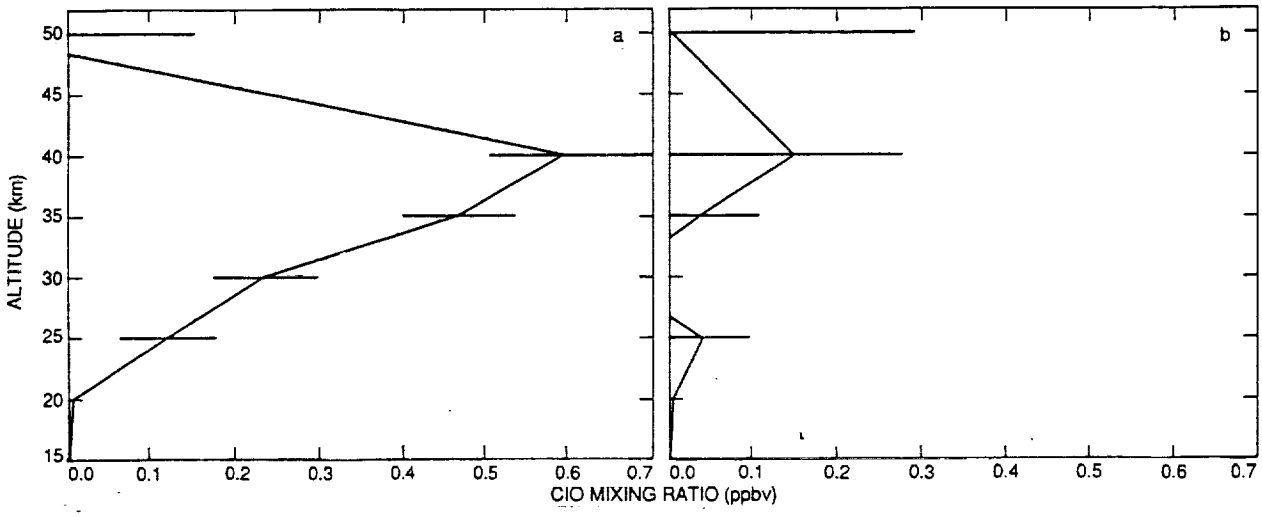

Figure 2: Retrieved ClO vertical profiles from *single* limb scans. Effective integration time is ~400 seconds for each profile. Profile times are: (a) 1245–1300 CDT 27 May 1989, and (b) 0200–0215 CDT 28 May 1989.

E. Journal Publications:

Waters, J.W., R.A. Stachnik, J.C. Hardy, R.F. Jarnot, "ClO and O_3 Stratospheric Profiles: Balloon Microwave Measurements", Geophys. Res. Lett., 15, 780–783, 1988.

Robbins, D., J. Waters, P. Zimmermann, R. Jarnot, J. Hardy, H. Pickett, S. Pollitt, W. Traub, K. Chance, N. Louisnard, W. Evans, and J. Kerr, "Ozone Measurements from the Balloon Intercomparison Campaign", J. Atmos. Chem., in press, 1989.